Family History of Diabetes as a Potential Public Health Tool

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Abstract: Given the substantial morbidity and mortality associated with type 2 diabetes, it is important that public health seek ways to delay or prevent the onset of this condition. Risk factors for type 2 diabetes are well established and include underlying genetic susceptibility. Despite this knowledge, as well as significant advances in understanding the human genome, the prevalence of type 2 diabetes continues to rise at an alarming rate. Because type 2 diabetes is a complex condition involving a combination of genetic and environmental factors, DNA testing for susceptibility genes is not yet warranted. However, because family history reflects genetic susceptibility in addition to other factors, it may be a useful public health tool for disease prevention. When evaluating family history as a public health tool, several important issues need to be considered, including the analytic and clinical validity and the clinical utility of using family history as a screening tool. These issues as well as a review of the epidemiologic evidence evaluating family history as a risk factor will be reviewed.

Overall, a family history approach appears to be a promising new public health tool to fight the growing epidemic of diabetes in the United States. Adequate levels of funding to further evaluate this approach and to develop appropriate tools should be made available for research activities focused on this important area. (Am J Prev Med 2003;24(2): 152–159) © 2003 American Journal of Preventive Medicine

Introduction

Type 2 diabetes is a significant public health problem, accounting for substantial morbidity and premature mortality in the United States. The estimated annual direct and indirect economic costs of managing type 2 diabetes and its sequelae are $98 billion.[1] The prevalence of type 2 diabetes among adults varies by age and ethnicity,[2] and it continues to rise at an alarming rate among youth.[3] Importantly, the public health burden of type 2 diabetes may be underestimated because approximately 33% to 50% of individuals with type 2 diabetes (about 8 million) remain undiagnosed and untreated.[2,4] Furthermore, it is estimated that diagnosis and treatment may be delayed 4 to 7 years; as a result, many patients with diabetes will already have complications of the disease by the time of clinical diagnosis.[5]

Risk factors for type 2 diabetes are well established[2] and include age, race and ethnicity, obesity, and lack of physical activity. The frequency of diabetes is greater among individuals with hypertension or dyslipidemia and in women with a prior history of gestational diabetes. Evidence for genetic susceptibility to type 2 diabetes is also well established.[6–10] However, the genetics of type 2 diabetes is complex, and it is unlikely that single major genes will account for a substantial proportion of the disease.

The American Diabetes Association (ADA) recently issued a position statement that included a review of four randomized controlled trials,[11–13] which showed that simple lifestyle modifications such as a healthy diet, increased physical activity, or pharmacologic interventions can significantly decrease the incidence of diabetes in high-risk populations.[14] Evidence from these studies suggests that preventing or delaying the onset of type 2 diabetes is possible. However, population screening for diabetes, even in high-risk populations, is not currently recommended by the ADA.[15] Thus, developing and evaluating strategies to identify at-risk individuals who may benefit from targeted interventions are important and challenging public health responsibilities.

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0749-3797/03/$–see front matter
doi:10.1016/S0749-3797(02)00588-3

Table 1. Risk of diabetes associated with a family history of diabetes

Study	Nation, population	Subgroup	Sample size	Risk estimate (p or 95% confidence interval) Mother	Father	Both parents	Other[a]
Cohort							
Knowler[17b,c]	U.S., Pima Indians		3137			3.9 ($p<0.001$)	2.3 ($p=0.04$)
Shaten[18b]	U.S., men (all races)		5905				2.0 (1.5–2.6)
Burchfiel[19b,c,d]	U.S., Japanese-American men		7210				1.7 (1.3–2.3)
Bjornholt[20b,c,e]	Norway, Oslo men		1947	2.5 (1.6–4.1)	1.4 (0.7–3.1)	4.0 (1.2–13.0)	
Meigs[21,b]	U.S., whites		2527	3.4 (2.3–4.9)	3.5 (2.3–5.2)	6.1 (2.9–13.0)	
Case–control							
Erasmus[22]	South Africa, blacks		1798				4.1 (3.0–5.5)
Cross-sectional							
Mitchell[23b,f]	U.S., Mexican Americans and non-Hispanic whites	Men	2116	3.4 (2.3–5.1)	3.5 (2.2–5.6)	3.7 (1.7–8.1)	
		Women	2798	2.0 (1.5–2.8)	1.4 (0.8–2.2)	2.6 (1.4–4.8)	
Lin[24]	Taiwan, Pu-Li		745	2.6 (1.1–5.7)	0.5 (0.0–2.9)		
Lin[24]	Taiwan, Chinshan	>60 years	3548	1.2 (0.4–3.1)	0.6 (0.0–3.3)		
		50–59 years	3524	1.6 (0.4–4.4)	2.8 (0.5–9.1)		
		40–49 years	3517	4.4 (1.7–10.1)	2.2 (0.3–8.9)		
Sargeant[25]	United Kingdom, Norfolk		6473				2.3 (1.7–3.1)
Thorand[26b]	Germany, Augsburg		13,428	2.8 (2.3–3.5)	2.7 (2.0–3.7)		

[a]Other refers to either parent except for Erasmus et al.[22] (any first-, second-, or third-degree relative) and Lin et al.[24] (any immediate family member).
[b]Adjusted for age.
[c]Adjusted for body mass index.
[d]Additional adjustment for subscapular/tricepts ratio, physical activity, glucose, triglycerides, hematocrit, and systolic blood pressure.
[e]Additional adjustment for fasting glucose, glucose disappearance rate, fitness, triglycerides.
[f]Adjusted for ethnicity.

Family history information may serve as a unique and useful tool for public health and preventive medicine.[16] Because family history reflects both genetic and environmental factors, it may serve as a better predictor of diabetes risk than either factor alone. If this is the case, family history could then be used to identify individuals at different levels of risk or to influence health promoting behaviors. Further, prevention efforts could be extended to family members who may be at increased risk or who may be influential in helping to modify a relative's health behavior.

The purposes of this paper are to review the epidemiologic evidence about family history as a risk factor for type 2 diabetes, to assess the analytic and clinical validity and the clinical utility of family history information as a screening tool for type 2 diabetes, to identify gaps in knowledge in these areas, and to illustrate the importance of ethnic and cultural considerations when collecting and using family history information.

Family History as a Risk Factor for Type 2 Diabetes

To assess the quality and consistency of the scientific literature evaluating the relationship between family history of diabetes and risk of type 2 diabetes, we conducted a PubMed search, using the terms "family history," "parental history," and "diabetes." We limited our review to studies that examined the association between family history of diabetes in any relative and clinically diagnosed diabetes.

The following is a summary of ten studies, including five cohort studies,[17–21] one case–control study,[22] and four cross-sectional studies[23–26] that report on the association between positive family history and type 2 diabetes. Table 1 gives a summary of the estimated risks reported in these studies according to family history of diabetes.

A long-term follow-up study conducted among a population of Pima Indians[17] showed that participants with one parent affected with diabetes were 2.3 times more likely to develop diabetes than participants who did not have affected parents ($p=0.039$), and participants with two affected parents were 3.9 times as likely to develop diabetes ($p=0.0003$). Among participants who had only one parent with diabetes, having a mother with diabetes was more common than having a father with diabetes, but this finding was not statistically significant ($p=0.15$).

Men participating in the control group of the Multiple Risk Factor Intervention Trial[18] with a parental history of diabetes were at twofold increased risk of developing diabetes compared with men with no parental history of diabetes (age-adjusted relative risk [RR]=2.01, 95% confidence interval [CI]=1.54–2.64). Further adjustments for race and medical and lifestyle risk factors diminished the risk associated with family

history, but the association remained statistically significant. The age-adjusted RR associated with a parental history of diabetes was nearly twice as great in blacks (RR=3.62, 95% CI=1.55–8.47) compared with nonblacks (predominantly whites; RR=1.85, 95% CI=1.38–2.48). Those authors did not report a formal statistical test for the interaction between race and parental history of diabetes.

A prospective study of Japanese-American men participating in the Honolulu Heart Program[19] showed an increased risk of incident diabetes among those with a parental history of diabetes (odds ratio [OR]=1.73, 95% CI=1.29–2.33). The association was slightly but not significantly stronger in men aged 45 to 54 years compared with men aged 55 to 68 years. Analyses were adjusted for age, body mass index (BMI), subscapular/triceps ratio, physical activity, glucose, triglycerides (TGs), hematocrit, and systolic blood pressure at baseline.

In an occupational cohort of healthy Caucasian men with normal fasting blood glucose, Bjornholt et al.[20] found an increased risk associated with family history of diabetes and some evidence for a greater effect of maternal diabetes (RR=2.51, 95% CI=1.55–4.07) compared with paternal diabetes (RR=1.41, 95% CI=0.66–3.05). Notably, those with a combined parental history were at further increased risk of developing diabetes compared with those with no parental history (RR=3.96, 95% CI=1.22–12.9). Analyses were adjusted for fasting glucose, glucose disappearance rate, BMI, fitness, TGs, and age.

In participants from the Framingham Offspring Study,[21] the age-adjusted risk associated with a history of maternal diabetes (OR=3.4, 95% CI=2.3–4.9) was similar to that for paternal diabetes (OR=3.5, 95% CI=2.3–5.2). The age-adjusted risk associated with both parents having diabetes was consistent with an additive risk model (OR=6.1, 95% CI=2.9–13.0).

Investigators from the Transkei region of South Africa reported the frequency of self-reported family history among black South Africans.[22] The unadjusted OR reported in Table 1 for that study was calculated from frequency data provided within the article. The risk associated with a positive family history of diabetes in any first-, second-, or third-degree relative was fourfold higher compared with those with no family history (OR=4.08, 95% CI=3.02–5.50).

The San Antonio Heart Study examined a large population sample of Mexican Americans and non-Hispanic whites.[23] Analyses stratified by gender and adjusted for age and ethnicity showed that men with diabetes were more than three times as likely to have a mother (OR=3.44, 95% CI=2.32–5.12), father (OR=3.49, 95% CI=2.16–5.64), or both parents (OR=3.73, 95% CI=1.72–8.08) with diabetes compared with men without diabetes. Among women, however, only maternal history (OR=2.03, 95% CI=1.47–2.81) or history in both parents (OR=2.59, 95% CI=1.41–4.77) were significantly associated with diabetes, while paternal history (OR=1.35, 95% CI=0.83–2.19) was not.

Lin et al.[24] carried out two independent surveys of the Taiwanese population. The first study showed that the risk of newly diagnosed diabetes was greater among residents with a maternal history of diabetes (OR=2.64, 95% CI=1.12–5.71) compared with residents with no parental history. However, this risk was not true for those with a paternal history of diabetes (OR=0.47, 95% CI=0.01–2.93), although the small numbers (only one diabetic person with a paternal history) could not rule out an increased risk. The second survey found that people with diabetes in all age groups (40–49, 50–59, 60+ years) were more likely to report a maternal history relative to a common control group without diabetes (OR=4.41, 95% CI=1.71–10.13; OR=1.57, 95% CI=0.40–4.41; and OR=1.22, 95% CI=0.38–3.05, respectively). In contrast, paternal history of diabetes was more common only among people with diabetes aged 40 to 49 and 50 to 59 years relative to the common control group and not among the 60 and older age group (OR=2.80, 95% CI=0.54–9.07; OR=2.21, 95% CI=0.25–8.86; and OR=0.56, 95% CI=0.01–3.31, respectively). Numbers in each age group were small, and only the association in the 40- to 49-year-olds with a maternal history reached statistical significance.

A cross-sectional population-based study conducted in the United Kingdom[25] found that participants with a positive family history of diabetes, defined as disease in any immediate family member, were more than twice as likely to have type 2 diabetes compared with participants with no family history (OR=2.30, 95% CI=1.72–3.09). In addition, a statistically significant interaction was observed between family history and BMI in subjects with a BMI greater than 27.5 kg/m^2 (p=0.049). The study also found that among those with a positive family history of diabetes, the prevalence of diabetes decreased with increasing occupational physical activity; however, this interaction was not significant (p=0.35).

Thorand et al.[26] studied a large group of participants in the MONICA Augsburg study over an 11-year period. The age-adjusted risk of diabetes was higher among people with a maternal history of diabetes (OR=2.8, 95% CI=2.3–3.5) or paternal history of diabetes (OR=2.7, 95% CI=2.0–3.7) compared with people with no parental history of diabetes. Further adjustments for gender and timing of survey did not materially alter estimates.

In summary, most studies reported a twofold to sixfold increased risk of type 2 diabetes associated with a positive family history compared with a negative family history of diabetes. These estimates are consistently elevated across different study designs and in several ethnic groups. Further, the risk associated with

family history appears to be independent of other known risk factors for type 2 diabetes, including age, BMI, glucose status, and smoking. The relative importance of maternal versus paternal diabetes is unclear, although one paper noted that the differences in the reported prevalence of maternal and paternal diabetes may be the result of missing information.[26] In contrast, results consistently indicate that people with a history of diabetes in both parents have an increased risk over those with only one parent; the increase in risk appears to be additive.

Several limitations of these family history studies deserve mention. First, the lack of a standard definition of family history and diabetes could lead to an underestimate or overestimate of the association because of misclassification. Although "family history" refers primarily to parental history in the studies analyzed, estimates from the two studies analyzing history in immediate family members[25] or any first-, second-, or third-generation family member[22] were similar. Second, few studies have validated diabetes status of relatives as reported by the proband. Third, among the case–control studies, there is potential for recall bias. Fourth, differences in level and quality of control for confounding factors may account for variation in risk estimates and significance of findings in studies. In general, the studies did not consistently evaluate tests of interaction between modifiable risk factors and family history, although individual studies suggested that positive family history of diabetes may interact with other known risk factors such as gender,[23] age,[19] race,[18] obesity,[25] or level of occupational physical activity[25] to increase the risk of type 2 diabetes. Finally, there is always the potential for publication bias when reviewing published studies.

Analytic and Clinical Validity

Analytic validity refers to how accurately and reliably family history information identifies disease among a person's relatives. Analytic validity is measured by calculating the sensitivity (identification of relatives with disease) and specificity (identification of relatives without disease). Clinical validity refers to how well family history can be used to stratify disease risk and to predict future disease in a person. The important measures are the positive and negative predictive values (i.e., the probability that a person will develop or not develop disease given that they have a positive or negative family history, respectively).

In the diabetes literature, we identified two studies that evaluated the analytic validity of family history in diabetes. In the Family Heart Study,[27] investigators determined the validity of reported family history of diabetes by comparing the proband's report with that of their relatives (reference standard). The sensitivity of the proband's report of diabetes was 0.87, 0.72, and 0.83 for parents, siblings, and spouses, respectively, and specificity was 0.98 for each relative type. In the San Luis Valley Diabetes Study,[28] there was complete agreement between proband and family reports, suggesting that family history information collected from the proband is reliable and accurate.

Those studies suggest that the analytic validity of family history of diabetes is high. However, to our knowledge, there have been no studies evaluating the clinical validity of family history and diabetes.

Clinical Utility

Although family history itself is a nonmodifiable risk factor, family history information can be useful for raising awareness of risk, risk stratification, targeting interventions, and positively influencing health behaviors. The clinical utility of family history information depends on its impact and usefulness to individuals, families, and society.[16] For example, family history information will be useful if it can be used to motivate effective behavior change. One factor that may influence health-related behavior change is risk perception. In addition, ethnic and cultural practices and beliefs contribute to the perception of risk for particular diseases and influence the application of interventions in specific populations. The following sections briefly describe results from selected studies that address risk perception and its effect on behavior modification, as well as present some ethnic and cultural elements that can influence behavior.

Risk Perception

The concept of perceived risk is a central construct in a number of theoretical models addressing health-protective behaviors, and it assumes that the higher the perceived threat, the more likely an individual will modify his or her behavior.[29,30] A number of factors influence threat of disease, including an individual's belief or perception about disease risk and severity. It has been hypothesized that individuals will change their behavior only if they perceive themselves to be at risk and believe that they can prevent disease.[31] Therefore, altering risk perception is a potential target for intervention. Here we focus on several aspects of risk perception (actual versus perceived risk, risk perception and behavior, and modification of risk perception) and behavior change in relation to family history and diabetes.

Actual Versus Perceived Risk

One aspect of risk perception concerns the degree of correlation between actual risk and perceived risk of type 2 diabetes in individuals with a positive family history. If an individual is at high risk of disease but does not perceive himself or herself to be at risk, then

the individual may not be motivated to attempt a change in lifestyle behaviors. We identified seven studies that addressed whether people with a positive family history perceived themselves to be at increased risk of diabetes compared with the general population.

Forsyth et al.[32] assessed perceived threat of illness in 30 offspring of individuals with type 2 diabetes versus 30 individuals with no reported history of chronic disease in either parent. The study found that those who had at least one parent with type 2 diabetes estimated themselves to be at a higher risk of diabetes compared with the control group. In a study of 154 overweight men and women with a family history of type 2 diabetes, Polley et al.[33] found that, although most participants rated diabetes as a very serious disease, only one third of participants perceived themselves to be at high risk of developing diabetes. Those who perceived themselves at highest risk had more relatives with diabetes and were more likely to be women than the subjects who considered themselves at moderate risk. A British study by Pierce et al.[34] assessed risk perception in 105 offspring of parents with type 2 diabetes. That study concluded that offspring with a parental history of diabetes are often aware of their increased risk of disease, but they often underestimate this risk and know little about preventive strategies. Another study by Pierce et al.[35] examined the extent to which parents with type 2 diabetes perceived their offspring to be at risk of developing diabetes. Fifty-six percent of the 159 participants worried that their offspring might develop diabetes, but only 32% thought it was likely and little was known about disease prevention. A separate study investigated risk perception among siblings of subjects with diabetes and found that, of the 454 subjects, 38% thought it was likely that they would develop diabetes.[36]

In addition, parental history of diabetes, gender, age, and perception of seriousness of diabetes were most strongly associated with increased perceived risk. Kim et al.[37] investigated perceived risk of diabetes in 101 Korean male offspring with one or both parents having type 2 diabetes and found that most offspring lacked knowledge about the increased risk among family members. Although 29% of nondiabetic male offspring between the ages of 19 and 28 years were concerned about diabetes, only 10% thought that they might develop diabetes. Recently, Harwell et al.[31] evaluated perceptions of diabetes risk and prevention in a population-based sample of adults aged 45 years and older from Montana. A total of 576 nondiabetic subjects were surveyed by telephone, and 38% reported a family history of diabetes. Family history of diabetes was the factor most strongly associated with perceived risk (OR=6.65, 95% CI=4.17–10.61), after adjusting for age, gender, BMI, high blood pressure, and high cholesterol. However, respondents with a family history of diabetes were less likely to believe that they could prevent diabetes compared with those with no family history (OR=0.65, 95% CI=0.45–0.93). Interestingly, few respondents reported receiving medical advice from healthcare providers about diabetes risk.

Overall, studies indicated that diabetic parents worry about diabetes occurrence among offspring, but fewer than 40% of people with a positive family history of the disease actually perceive themselves to be at increased risk. In addition, although the perceived risk of developing diabetes in those with a family history of disease may be greater than the general population, the perceived risk is an underestimation of the actual risk of developing disease, as assessed through the use of family history information. However, the characterization of actual risk is not often correlated with risk estimations from well-designed epidemiologic studies and there is no consistent definition of high risk. Increasing awareness of family history as a risk factor for diabetes in at-risk individuals and their families may be beneficial.

Risk Perception and Behavior

In addition to assessing the correlation between perceived risk and actual risk, it is important to understand the relationship between understood personal risk and health behaviors motivated by the risk perception. Do people with a positive family history of diabetes, who presumably perceive themselves to be at increased risk, engage in protective behavior? The previously mentioned study by Forsyth et al.[32] found that individuals with a parental history of diabetes reported more frequent health protective behaviors (e.g., weight reduction, diet, exercise, and physician checkups) than the control group. Another study conducted in Montana residents 45 years and older found that participants were more likely to report being screened for diabetes if they had a positive family history.[38] After adjusting for age, number of healthcare visits during the past year, hypertension, and high cholesterol, those with a positive family history were 45% more likely to report being screened for diabetes during the past year compared with those with no family history (95% CI=1.12–1.89). In the San Luis Valley Diabetes Study,[28] a positive family history of diabetes was associated with increased reported screening in both Hispanics and Caucasians. These studies suggest that some individuals with a positive family history of diabetes do engage in health protective behaviors.

Manipulation of Risk Perception

In order for family history information to be useful in preventing type 2 diabetes, it must be useful in altering risk perception. There have been no studies in the diabetes literature that specifically addressed manipulation of risk perception in those with a family history of type 2 diabetes, although studies in other areas have demonstrated a direct relationship between altering

risk perception and changing behavior. A recent review of several randomized trials suggested that providing individuals with biological information that convey disease risk or harm, including markers of genetic susceptibility, may enhance health behavior change.[39] However, more research in this area was suggested. Furthermore, altering risk perception raises important ethical issues. An alteration of risk perception may not be useful if it does not stimulate healthy behavior, or if the changed behavior is not effective in preventing disease or reducing morbidity. In addition, alterations in risk perception may actually be detrimental if these perceptual alterations cause undue worry in the individual.

Manipulation of Behavior

Finally, does changing behavior in individuals with a positive family history of diabetes lead to disease prevention? Sufficient evidence exists from randomized controlled trials and observational studies that type 2 diabetes can be prevented or delayed by adopting simple, healthy lifestyle changes, such as healthy diet and exercise. Recently, both the Diabetes Prevention Program (DPP)[12] and the Finnish Diabetes Prevention Study[11] showed a 58% relative reduction in the incidence of diabetes in the lifestyle-intervention groups compared with the control group. The Finnish study recruited high-risk subjects primarily through screening first-degree relatives of patients with type 2 diabetes.[11] Although the DPP study[12] did not include family history as an eligibility criteria, more than 69% of their high-risk participants had a positive family history of diabetes. Wing et al.[40] conducted a lifestyle-intervention study in individuals aged 40 to 55 years who were 30% to 100% overweight and had one or both parents with diabetes. Their study also showed that the diet as well as the diet-and-exercise combined intervention groups were most effective in decreasing weight compared with the control and exercise-alone groups. The study concluded that even a modest weight loss of 4.5 kg at 2 years significantly reduced the risk of developing diabetes by 30% relative to those with no weight loss. However, adherence to the interventions decreased over the course of the study.

In summary, an examination of the available literature shows that actual risk and perceived risk of having a family history of diabetes are incongruent; the relationship between risk perception and behavior is still uncertain; and although a weight loss intervention may reduce the risk of developing type 2 diabetes for those with a family history, there is still insufficient evidence about the effect of accurate risk perception on behavior change. Only a few studies have been published specifically on risk perception and behavior modification in those with a family history of diabetes. No studies were identified examining the effect of altering risk perception on behavior. It is also important to note that perceived risk is only one variable that may influence behavior change. Other factors, including worry, social influences, physician counseling, perceived threat, and practical experience or intellectual familiarity with the disease, can also influence behavior.[29,41]

Ethnic and Cultural Considerations

Because several ethnic minority groups have higher rates of diabetes compared with Caucasians, those with a positive family history are important targets for public health campaigns to reduce or prevent diabetes. Anthropomorphic and genetic variability by ethnicity may reflect different susceptibilities to diabetes. Consequently, weight-related criteria for risk estimation and genetic predispositions to diabetes may vary among ethnic populations.[42,43] In addition, cultural factors may affect the clinical validity and utility of family history information; therefore, it may be necessary to develop a series of culturally specific instruments. Understanding potential cultural differences will be an important first step in designing such instruments and then using the resulting information for prevention efforts.

Culturally appropriate assessment of family history and interventions for high-risk populations need to take into account cultural variation by disease susceptibility, healthcare access, disease definition, risk estimation, and lifestyle behaviors, among other things. How a condition is labeled, or whether it is defined as abnormal, has both research and clinical implications. For example, results from a study assessing family history data collection among Pacific Islanders living in the United States indicated that accessibility to health care was variable and that many conditions went unreported and undiagnosed. Study subjects did not always report diabetes among family members because it was considered a normal part of aging rather than a potentially preventable disease. In another study, rural African Americans, who defined diabetes as "sugar" or "sugar-diabetes," believed their condition was less serious and had higher glucose levels than those who defined their disease as diabetes.[44]

Perception of risk and endorsement of disease prevention activities also vary among groups. One's orientation to time, the values of fate, and belief in destiny influence the ways in which risk is assessed. Activities to prevent a disease that may occur in the distant future are more likely to be successful in groups oriented to the future. Those with a greater focus on the past or on the present are more accustomed to treating symptoms as they appear and may not find preventive messages compelling. Concepts of fate and destiny are related to agency and whether one's actions can affect change.

Two studies conducted with Native-American[45] and Native-Hawaiian populations[46] identified several factors

that influenced participation in lifestyle-intervention programs to reduce diabetes in these ethnic groups. The factors included conflicts with community activities and beliefs or attitudes about diabetes, such as knowledge of program and recruitment methods.[45] Stage of change, a hypothesized mediator of behavior change, was also found to be an important factor in mediating lifestyle behavior change in persons with or at risk of diabetes in Native Hawaiians.[46] Therefore, intervention programs will likely need to be tailored to culturally distinct populations.

More research on clinical utility, including the role of risk perception and the influence of social and cultural factors, is necessary to better understand the utility of family history as a public health tool for prevention of type 2 diabetes.

Conclusion

This review focused on an evaluation of risk of diabetes associated with a positive family history of diabetes and on aspects of evaluating the analytic and clinical validity as well as the clinical utility of family history information. Despite the limitations outlined in this paper, epidemiologic studies examining the association between type 2 diabetes and family history consistently find that a positive family history among first-degree relatives confers an increased risk of type 2 diabetes and that the risk is greater when both parents are affected. However, estimates of risk associated with more distant or multiple-affected relatives are scarce as are evaluations of interactions between family history and other known risk factors.

Importantly, numerous studies suggest that exercise, dietary interventions, and weight loss are reasonably effective in reducing the risk of type 2 diabetes. However, little is known about these or other prevention strategies in families with a positive history of diabetes. The studies that have addressed the role of family history information in risk perception and prevention of type 2 diabetes indicate that perceived risk associated with a positive family history of the disease is less than the actual risk. In addition, the effect of risk perception on behavior modification is still unclear, but it appears that increasing risk perception may result in some types of health protective behaviors. Currently, data on the effect of family history information on prevention, screening, and treatment behaviors is limited, and more research on the clinical utility of family history as a public health tool is needed.

Identifying individuals at risk of type 2 diabetes early on for targeted intervention could substantially reduce the burden of disease in the population. Using family history information as a screening tool is appealing because it is easy and inexpensive to collect in both the clinical and community setting, and because prevention can be targeted to the individual or extended to the family. Currently, several groups have developed simple diabetes screening tools, which incorporate family history information along with other established risk factors, to identify at-risk individuals or to stratify the population so that only those at highest risk are offered further diagnostic testing.[47–49] However, these screening tests may not be useful in practice, as they have low clinical validity (only 10% positive predictive value[47]), and family history and other risk factor information necessary to calculate risk scores are generally missing from medical charts.[49]

Overall, the use of family history information as a public health tool appears very promising, but it requires further research or evaluation in the following areas: (1) accurate estimates of the risk associated with a positive family history of the disease and estimates of attributable risk and population attributable risk; (2) evaluation of potentially modifiable factors that interact with family history; (3) conclusive data on the clinical utility of family history information, including the effect knowledge of family history has on preventive, screening, and treatment behaviors; (4) a standardized and validated family history tool and scoring scheme for risk stratification and comparison with existing tools that include family history; (5) further assessment of the clinical validity of family history information in different ethnic groups; and (6) an examination of the ethical, legal, and social issues that may influence the validity and utility of family history information in different populations.

In conclusion, studies show an association between a positive family history and an increased risk of type 2 diabetes. Further research on the extent to which knowledge about this association will influence risk perception and behaviors will help determine if a family history approach can be used effectively to fight the increasing epidemic of diabetes in the United States. Adequate levels of funding to further evaluate this approach and to develop appropriate tools should be made available for research activities focused on this important area.

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The authors would like to thank Ms. Lindsay Hampson and Ms. Miriam Fay for their helpful comments.

This project was supported under a cooperative agreement from the Centers for Disease Control and Prevention (CDC) through the Association of Schools of Public Health. Grant Numbers U36/CCU300430-20 and U36/CCU300430-22. The contents of this article are solely the responsibility of the authors and do not necessarily represent the official views of CDC or ASPH. Ms. Lucia Hindorff is a Howard Hughes Medical Institute Predoctoral Fellow, and Ms. Helen Kim is supported by a Cardiovascular Epidemiology training grant

(5T32 HL007902) from the National Heart, Lung, and Blood Institute.

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